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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/986,919	11/13/2001	Jeawoan Lee	1567.1021	6274

21171 7590 09/21/2004

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EXAMINER	
TSANG FOSTER, SUSY N	

ART UNIT	PAPER NUMBER
1745	

DATE MAILED: 09/21/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/986,919	LEE ET AL.	
	Examiner	Art Unit	
	Susy N Tsang-Foster	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *06 July 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-31,42 and 43* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-31,42 and 43* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. This Office Action is responsive to the amendment filed on 7/6/2004. Claims 1-3, 13-15, 18, 25 30, and 31 are amended. Claims 32-41 are cancelled. Claims 42 and 43 are added. Claims 1-31, 42, and 43 are pending. Claims 1-31, 42, and 43 are finally rejected for reasons necessitated by applicant's amendment.

Specification

2. The amendment filed 7/6/2004 is objected to under 35 U.S.C. 132 because it introduces new matter into the disclosure. 35 U.S.C. 132 states that no amendment shall introduce new matter into the disclosure of the invention. The added material which is not supported by the original disclosure is as follows: In paragraph 15, changing "98%" to "90%" constitutes new matter since the amendment has changed the scope of essential subject matter in the specification.

Applicant is required to cancel the new matter in the reply to this Office Action.

3. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required:

In claim 4, the limitation "at least 80 to 90%" is not in the specification.

In claims 16 and 42, the limitation "80 to 90% porosity" is not in the specification.

In claim 43, the limitation "60 to 90% porosity" is not in the specification.

Claim Objections

4. Claims 3, 4, 15, and 16 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form.

In claims 3 and 15, the limitation "at least 80%" which encompasses 90% does not further limit claim 1 which recites "at or greater than 60% porosity and less than 90% porosity".

In claim 4, the limitation "at least 80 to 90% porosity" does not further limit claim 1 which does not include 90% porosity.

In claim 16, the limitation ""80 to 90%" does not further limit claim 1 which does not include 90% porosity.

Claim Rejections - 35 USC § 112

5. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

6. Claims 1-24 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant

art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In claims 1 and 13, the limitation "a current collector having pores comprising at or greater than 60% porosity and less than 90% porosity based on an overall volume of said current collector" is not in the original disclosure. The numerical ranges in the original disclosure do not show that applicant possessed at the time the invention was made less than 90% porosity but greater than or equal to 60%. Furthermore, the original disclosure does not include any data to appreciate that less than 90% porosity is significant to applicant's invention.

Claims depending from claims rejected under 35 USC 112, first paragraph are also rejected for the same.

Claim Rejections - 35 USC § 103

7. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

8. Claims 1-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu et al. (US 6,030,720) in view of Peled et al. (US Pat. No. 4,410,609).

The product-by-process limitations of claims 5, 9, 10, 17, 18, 21, and 22 are not given patentable weight since the courts have held that patentability is based on a product itself, even if the prior art product is made by a different process (see In re Thorpe, 227 USPQ 964, (CAFC 1985), In re Brown, 173 USPQ 685 (CCPA 1972), and In re Marosi, 218 USPQ 289, 292-293 (CAFC 1983)).

In claim 5, the product by process limitation "wherein said porous current collector comprises a resin foam coated with a metal, where the coated resin foam is subjected to a pyrolysis process" is not given patentable weight in a product claim. Therefore, a porous metallic current collector would meet the claim limitation.

In claim 9, the product by process limitation "wherein the metal is coated using a coating method that comprises one of electroplating and electroless plating" is not given patentable weight in a product claim.

In claim 10, the product by process limitation "wherein the metal is coated using a coating method that comprises one of electroplating and electroless plating" is not given patentable weight in a product claim.

In claims 17 and 18, the product by process limitation "wherein the porous current collector comprises a resin foam coated with metal, where the coated resin foam was subjected to a pyrolysis process" is not given patentable weight in a product claim. Therefore, a porous metallic current collector would meet the claim limitation.

In claim 21, the product by process limitation "wherein the metal is coated using a coating method that is one of electroplating and electroless plating" is not given patentable weight in a product claim.

In claim 22, the product by process limitation "wherein the metal is coated using a coating method that is one of electroplating and electroless plating" is not given patentable weight in a product claim.

The present claims are drawn to a positive electrode comprising a sulfur based active material and a lithium sulfur battery comprising the positive electrode comprising a sulfur based active material where the disclosed inventive concept appears to be a positive electrode porous current collector in which the sulfur based active material is disposed.

Chu et al. disclose a lithium sulfur battery comprising a positive electrode comprising a current collector that can be a conductive foam or a thin conductive grid such as a metal-coated polymer fibers or weaves in which the positive electrode material is interspersed throughout the matrix provided by the current collector (col. 9, lines 15-37 and Figures 2A and 2B). Conductive foam or thin conductive grid such as a metal coated polymer fibers or weaves inherently are porous since they provide a matrix in which the positive electrode material is interspersed. The reference also states that the matrix is sufficiently "open" that there is room for precipitated electroactive material to deposit on the matrix (col. 10, lines 39-56). The positive electrode material is interspersed through the matrix provided by the current collector (col. 9, lines 27-30). Current collector materials may be made of a material such as aluminum that is resist to degradation in the electrochemical environment of the cell (col. 8, lines 13-34).

The positive electrode material may be elemental sulfur, sulfides, polysulfides, redox sulfur polymers (col. 6, lines 5-42 and col. 19, lines 6-15), and Li_2S_x where x is a value of 1 or greater (col. 9, lines 40-55). The positive electrode material may be interspersed into the current collector material by providing a slurry containing the sulfur based active material, a suitable binder, electroconductive agent, and solvent (col. 17, lines 24-40) and coating the slurry onto a porous current collector such as carbon fiber paper (col. 17, lines 30-35) where the *carbon fiber* paper is impregnated with the slurry and the solvent is evaporated (col. 23, lines 23-50 and col. 19, lines 45-58).

The negative electrode material may be lithium metal, lithium alloy, carbon based-lithium ion which reversibly intercalates and deintercalates lithium ions (col. 21, lines 1-46). A separator separates the positive electrode and the negative electrode and may be glass, plastic, ceramic, or a polymeric entraining liquid electrolyte (col. 8, lines 43-61). The battery contains a liquid electrolyte containing a lithium salt which impregnates (permeates) the negative electrode, positive, electrode, and separator (col. 14, lines 43-67 and col. 16, lines 1-6) and where the electrolyte also transfers lithium metal ions (col. 10, lines 1-6).

Chu et al. ('720) do not disclose that the current collector comprises at least 60% porosity and less than 90% porosity based on an overall volume of the current collector.

Peled et al. teach a lithium-sulfur battery comprising a positive electrode current collector that is porous and the porosity of the positive electrode current collector is advantageously about 80% or 75-90% (col. 4, lines 1-23).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the porosity of the current collector of Chu et al. ('720) to be 80% porous because such porosity would provide a cathode with high porosity so as to allow extensive electrolyte solvent communication throughout the bulk of the cathode and increased loading of the cathode active material would increase cathode real surface area which in turn would greatly improve cell current density.

9. Claims 25-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al. (US 6,503,432 B1) in view of Turi et al. (US Pat. No. 5,478,676).

Barton et al. disclose a lithium battery comprising a positive electrode which can comprise sulfur compounds (col. 1, lines 29-35; col. 10, lines 1-20), a negative electrode which can comprise lithium alloys, carbons such as coke or graphite (col. 9, lines 9, lines 40-65), a polymer electrolyte which functions as a separator and an electrolyte (col. 8, lines 1-5) and includes polyvinylidene fluoride, polyalkylene oxides (col. 7, lines 55-67). The electrolyte contains lithium salts (col. 9, lines 1-10). The polymer electrolyte contains 20-80wt% of a solvent/plasticizer which gels the polymer electrolyte and the polymer itself is the gelling agent in the electrolyte (col. 11, lines 10-29). The current collector for the positive electrolyte may be a porous substrate such as a metal mesh, metal foam and the current collector may be coated with a primer layer to prevent corrosion, to reduce interfacial resistance and improve adhesion to other layers and suitable primer layers are disclosed in U.S. Patent No. 5,478,676 to Turi et al. (col. 12, lines 15-35). Suitable metals for use in the current collector include aluminum, and nickel (col. 12, lines 15-35).

Barton et al. does not explicitly disclose that the metallic current collector is coated with carbon.

Turi et al. (U.S. Patent 5,478,676) teaches coating a current collector with a conductive primer layer comprising carbon black as a conductive filler to improve contact and adhesion of the electrode layer to the current collector (see abstract and col. 4, lines 30-40).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to coat the porous current collector of Barton et al. with conductive primer layer comprising carbon black in order to improve the adhesion of the positive electrode active material with the current collector in addition to improved electrical conductivity.

10. Claims 25-28, 30 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu et al. (US 6,030,720) in view of Turi et al. (U.S. Patent 5,478,676).

Chu et al. disclose a lithium sulfur battery comprising a positive electrode comprising a current collector that can be a conductive foam or a thin conductive grid such as a metal-coated polymer fibers or weaves in which the positive electrode material is interspersed throughout the matrix provided by the current collector (col. 9, lines 15-37 and Figures 2A and 2B). Conductive foam or thin conductive grid such as a metal coated polymer fibers or weaves inherently are porous since they provide a matrix in which the positive electrode material is interspersed. The reference also states that the matrix is sufficiently "open" that there is room for precipitated electroactive material to deposit on the matrix (col. 10, lines 39-56). The positive electrode material is interspersed through the matrix provided by the current collector

(col. 9, lines 27-30). Current collector materials may be made of a material such as aluminum that is resist to degradation in the electrochemical environment of the cell (col. 8, lines 13-34).

The positive electrode material may be elemental sulfur, sulfides, polysulfides, redox sulfur polymers (col. 6, lines 5-42 and col. 19, lines 6-15), and Li_2S_x where x is a value of 1 or greater (col. 9, lines 40-55). The positive electrode material may be interspersed into the current collector material by providing a slurry containing the sulfur based active material, a suitable binder, electroconductive agent, and solvent (col. 17, lines 24-40) and coating the slurry onto a porous current collector such as carbon fiber paper (col. 17, lines 30-35) where the *carbon fiber* paper is impregnated with the slurry and the solvent is evaporated (col. 23, lines 23-50 and col. 19, lines 45-58).

The negative electrode material may be lithium metal, lithium alloy, carbon based-lithium ion which reversibly intercalates and deintercalates lithium ions (col. 21, lines 1-46). A separator separates the positive electrode and the negative electrode and may be glass, plastic, ceramic, or a polymeric entraining liquid electrolyte (col. 8, lines 43-61). The battery contains a liquid electrolyte containing a lithium salt which impregnates (permeates) the negative electrode, positive, electrode, and separator (col. 14, lines 43-67 and col. 16, lines 1-6) and where the electrolyte also transfers lithium metal ions (col. 10, lines 1-6).

Chu et al. ('720) does not explicitly disclose that the metallic current collector is coated with carbon.

Turi et al. (U.S. Patent 5,478,676) teaches coating a metallic current collector with a conductive primer layer comprising carbon black as a conductive filler to improve contact and adhesion of the electrode layer to the current collector (see abstract and col. 4, lines 30-40).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to coat the porous metallic current collector of Chu et al. with conductive primer layer comprising carbon black in order to improve the adhesion of the positive electrode active material with the current collector in addition to improved electrical conductivity.

11. Claims 29, 42 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chu et al. (US 6,030,720) in view of Turi et al. (U.S. Patent 5,478,676) as applied to claim 25 above, and further in view of Peled et al. (US Pat. No. 4,410,609).

Chu et al. as modified by Turi et al. disclose all the limitations of claims 29, 42, and 43 (see above) except that the current collector comprises at 60% porosity and less than 90% porosity based on an overall volume of the current collector.

Peled et al. teach a lithium-sulfur battery comprising a positive electrode current collector that is porous and the porosity of the positive electrode current collector is advantageously about 80% or 75-90% (col. 4, lines 1-23).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the porosity of the metallic current collector of Chu et al. ('720) as modified by Turi et al. to be 80% porous because such porosity would provide a cathode with high porosity so as to allow extensive electrolyte solvent communication throughout the bulk of the cathode and increased loading of the cathode active material would increase cathode real surface area which in turn would greatly improve cell current density.

12. Claims 29, 42, and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Barton et al. (US 6,503,432 B1) in view of Turi et al. (US Pat. No. 5,478,676) as applied to claim 25 above, and further in view of Peled et al. (US Pat. No. 4,410,609).

Barton et al. (US 6,503,432 B1) as modified by Turi et al. (US Pat. No. 5,478,676) disclose all the limitations of claims 29, 42, and 43 (see above) except that the porous current collector is at least 60%, 80 to 90% or 60 to 90% porous.

Peled et al. teach a lithium-sulfur battery comprising a positive electrode current collector that is porous and the porosity of the positive electrode current collector is advantageously about 80% or 75-90% (col. 4, lines 1-23).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the porosity of the current collector of Barton et al. to be 80% porous because such porosity would provide a cathode with high porosity so as to allow extensive electrolyte solvent communication throughout the bulk of the cathode and increased loading of the cathode active material would increase cathode real surface area which in turn would greatly improve cell current density.

Response to Arguments

13. Applicant's arguments with respect to claims 1-31, 42, and 43 have been considered but are moot in view of the new ground(s) of rejection.

With respect to the Examiner's interpretation of the limitations in instant claims 5, 17, and 18 as product-by-process limitations, applicant argues that the pyrolysis structure defines a type of coated foam structure and that such a structure resulting from the pyrolysis process as

recited in these claims should be given patentable weight, and that the Examiner's interpretation of the structure is unduly broad and does not reflect the invention.

In response, the final structure of the porous current collector of claims 5, 17, and 18 (when the conductive agent is for example polyaniline, polythiophene, polyacetylene as disclosed in paragraph 20 of the instant specification which would be removed from the current collector after the pyrolysis step) does not contain a resin foam since it was subjected to a pyrolysis process and what remains is a metallic conductive foam which is not structurally different from the metallic conductive foam disclosed by Chu et al. ('720). Applicants have not experimentally shown that a metallic conductive foam obtained by a resin coated with a metal and then subjecting the coated resin foam results in a structurally different metallic conductive foam. Therefore, the Examiner maintains the product-by-process interpretation for the limitations in claims 5, 17, and 18.

Conclusion

14. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37

CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications should be directed to examiner Susy Tsang-Foster, Ph.D. whose telephone number is (571) 272-1293. The examiner can normally be reached on Monday through Friday from 9:30 AM to 6:00 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached at (571) 272-1292.

The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

st/ Susy Tsang-Foster

Susy Tsang-Foster
Primary Examiner
Art Unit 1745